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A Summary of Current Program 7/1/66
and Preliminary Report of Progress
for 7/1/65 to 6/30/66

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STANDARDS AND RESEARCH DIVISION
of the
STATISTICAL REPORTING SERVICE
UNITED STATES DEPARTMENT OF AGRICULTURE
and related work of the
STATE AGRICULTURAL EXPERIMENT STATIONS

This progress report is primarily a tool for use of scientists and administrators in program coordination, development, and evaluation; and for use of advisory committees in program review and development of recommendations for future research programs.

The summaries of progress on USDA and cooperative research include some tentative results that have not been tested sufficiently to justify general release. Such findings, when adequately confirmed, will be released promptly through established channels. Because of this, the report is not intended for publication and should not be referred to in literature citations. Copies are distributed only to members of Department staff, advisory committee members, and others having special interest in the development of public agricultural research programs.

This report also includes a list of publications reporting results of USDA and cooperative research issued between July 1, 1965 and June 30, 1966. Current agricultural research findings are also published in the USDA publications, Agricultural Economics Research and Farm Index. This progress report was compiled in the Standards and Research Division, Statistical Reporting Service, United States Department of Agriculture, Washington, D. C.

UNITED STATES DEPARTMENT OF AGRICULTURE

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INTRODUCTION

There are three Divisions in the Statistical Reporting Service: Agricultural Estimates, Field Operations, and Standards and Research. The Agricultural Estimates Division is located in Washington, D. C. It administers crop and livestock estimating programs designed to provide current information about crop acreages and production, livestock numbers, and other statistics pertaining to the agricultural economy. The Field Operations Division has its headquarters in Washington, D. C., but it administers the field operational activities of the crop and livestock estimating and reporting programs through the medium of 43 field offices which serve the 50 States. The Standards and Research Division, also located in Washington, D. C., administers programs which include the research activities of SRS as well as statistical clearance. The research is conducted by the Special Surveys and the Research and Development Branches; both Branches perform service as well as research activities.

The Special Surveys Branch conducts research on the behavior, opinions, and preferences of consumers which affect their purchase and use of agricultural products or end products. These studies provide information of value in planning improved marketing of agricultural products, setting or revising grades and standards, and indicating areas requiring technical research to provide product qualities and characteristics which more closely satisfy consumer demand. The findings can be utilized to increase marketing and merchandizing efficiency all along the distribution line so that returns to producers can be improved and at the same time the satisfaction of consumers increased. The Special Surveys Branch also conducts research on reactions of agricultural programs and services which is designed to provide insights into measures which might be taken to increase their effectiveness.

The Research and Development Branch conducts research on sampling and survey methods as applied to the data collection activities of SRS, and development of techniques of statistical measurement applicable to substantive research.

The work of these Branches is being performed by a staff of about 22 professional employees. Part of the research is conducted by contract with private research organizations and cooperative agreements with land-grant colleges or producer and processor groups. On occasion, funds are transferred to the Division by other government agencies or farm organizations to finance special research studies undertaken at their request.

Some of the more noteworthy recent applications resulting from the research conducted by the Division are outlined below.

Results of studies conducted by the Special Surveys Branch on consumers' opinions of agriculturally-produced materials in various end uses have been used by natural fiber organizations to evaluate the position of cotton and wool in specific segments of the textile industry, and to encourage and guide private industry's efforts to improve the attributes of natural fibers

so that they can compete more successfully with synthetics. In addition, each year the National Cotton Council of America bases a major portion of its promotion for consumers and retailers on these research results; these reports have also been used as standard examples in the market development program of Cotton Council International.

The results of a study acceptance by a panel of consumers of instant sweet-potato flakes, which were developed by the Southern Utilization Research and Development Division, ARS, indicated considerable commercial potential for the new product. This conclusion is similar to that drawn from the results of an earlier study to measure consumer's reactions to instant white potato flakes. The acceptance of the white flakes has been a major contributing factor to halting the downward trend of per capita potato consumption. Since the publication of the final results of the sweetpotato flakes survey, a number of processors have begun producing the sweetpotato flakes.

The Special Surveys Branch has also conducted a number of studies in cooperation with the Economic Research Service to evaluate the market potential for new or improved products developed by the USDA's Utilization Research Regional Laboratories. One of these projects indicated that a new super-concentrated apple juice, which was processed in such a way that the fruit juice aromas which would otherwise be lost were recovered, was well received by household consumers in a test market city. The firm that originally cooperated with the Department in the first market test of the new juice subsequently undertook production of the juice with some variations from the Eastern Utilization Research and Development Division's original process. Preference tests in the Special Surveys Branch's sensory evaluation laboratory indicated that the variant product was much less acceptable to consumers than juice prepared by the original process. Market tests of the variant product were discontinued pending further technical research on product improvement.

The improved survey methods developed by the Research and Development Branch are being put into operation by SRS as rapidly as resources will permit. In June 1966, the enumerative survey program was expanded to include 39 States at an operating level, and 9 States on a semi-operational level. Objective yield surveys for corn and cotton were also conducted--corn in 33 States, and cotton in 13 States. The 1966 winter wheat survey included 15 States. The research program which produced the methodology for these surveys is coming into fruition through their incorporation into the operating program of SRS. Work is being continued both in survey methods and in objective yields.

AREA NO. 1: CONSUMER PREFERENCE AND QUALITY DISCRIMINATION--
HOUSEHOLD AND INDUSTRIAL

Problem. Domestic consumption of agricultural commodities depends on the behavior of some 190 million consumers. But, in our complex marketing economy, it has become almost impossible for consumers to discuss their preferences, opinions, and dissatisfactions with producers and marketers. Knowledge of consumer reactions to agricultural products is becoming increasingly important because we are in a period of rapid change: There is a growing challenge to farm products and farm income from a wide variety of competitive products of nonagricultural origin; there is a proliferation of mixtures, forms, processes and other innovations affecting farm products; and there is increasing awareness that mistakes in developing, producing, and marketing farm products are costly not only to the farmer but to processors and handlers as well. An understanding of consumer reactions and the reasons behind them is essential to planning improvements in the production, marketing, and processing of agricultural products, developing educational programs, setting or revising grades or standards, evaluating new products developed by the Department's Utilization Laboratories, and identifying areas on which technical research should be focused to provide farm products in the forms and with the characteristics that will increase consumer acceptance and more closely satisfy consumer demand.

USDA PROGRAM

The Special Surveys Branch provides the consumer, in a scientific and unbiased manner, with an opportunity to say what he or she thinks about agricultural products by conducting applied research among representative samples of household, industrial, or institutional consumers and potential consumers. Such research may determine preferences, opinions, buying practices, and use habits with respect to various agricultural commodities; the role of competitive products; acceptance of new or improved agricultural products, consumers' ability to discriminate among products with varying attributes, and the preferences associated with specific forms. These studies of the opinions, preferences, knowledge and habits of consumers which affect their purchase and use of farm products provide a line of communication from consumers back to those concerned with production, and marketing, and are complementary to the marketing and economic research of the Economic Research Service and the Consumer and Marketing Service as well as to utilization research of the Agricultural Research Service.

In addition to conducting studies of consumer preference and discrimination, the Branch also provides consultants and conducts special studies, upon request, for other agencies in the USDA or within the Federal Government, when survey methods can be usefully applied to the evaluation of programs, services, or regulatory procedures of interest to the requesting agencies.

The research is carried out in cooperation with other USDA or federal agencies, state departments of agriculture, experiment stations, land-grant colleges, and agricultural producer, processor, and distributor groups. Closely supervised contracts with private research firms are used for nationwide surveys; studies in selected areas are sometimes conducted by the Washington staff with the assistance of locally recruited personnel.

The Branch maintains all of its research scientists, who are trained in social psychology or other social sciences, in Washington, D. C., which is headquarters for all the research whether it is conducted under contract or directly by the Branch. The Federal scientific effort devoted to research in this area during the past year totaled 7 scientific man-years.

REPORT OF PROGRESS FOR USDA AND COOPERATIVE PROGRAMS

A. Consumer Preference

1. Fibers in wearing apparel. A nationwide survey is being conducted under contract by a private market research firm to ascertain women's opinions about fibers in apparel for warmer weather. Two types of questionnaires--one structured and the other with many questions unstructured--were employed in the final interviewing, which took place in the Fall of 1965. Coding and tabulation of the data have been completed, and a final report presenting the findings is in preparation.

A contract study on reactions to fibers in selected items of clothing among a nationwide sample of teenage boys and girls has been completed, and the final publication which presents detailed findings has been released. Some highlights of the findings follow.

The teenage boys and girls interviewed reported that cotton, wool, and cotton-polyester blends--the three most frequently owned and preferred materials in the garments selected for study--have their good points, but a few bad ones too. The major reasons given for preferring cotton were that it is cool, easy to wash and iron, nonirritating, durable, and not too warm. The main disadvantages mentioned were that cotton wrinkles and that it is not warm enough for some purposes. Wool was preferred mainly for its warmth and wrinkle resistance, but also for its soil resistance and durability. The complaints against wool were that it irritates the skin, that it is not washable, and that it is too warm. Cotton-polyester was liked because it is wrinkle resistant and easy to iron. A disadvantage of cotton-polyester mentioned by the girls was that it discolors. The girls were more likely to give launderability features (such as easy to wash, easy to iron) as reasons for their preferences than the boys were. This is presumably because girls are more likely than boys to take charge of caring for their clothes.

The majority of the teenagers reported that they were very interested in both the kinds of clothes they wore and the selection of the clothes. Although a majority of both the girls and boys reported that they were the ones who suggested the need for a new item of clothing, they said that their mothers usually had the most to say about whether or not they might buy it. However, boys were more likely than girls to mention that their fathers had the most to say about whether or not they would get a new item of clothing. The teenagers were more likely to say that they themselves suggested the need for and had the most to say about the purchase of girls' skirts or blouses and boys' shirts or sweaters than about girls' coats and dresses or boys' outer jackets and sport coats, which would generally be more expensive.

The majority of the girls reported that they either shopped alone or shopped with their mothers for their clothing, while the boys most frequently said that they shopped alone or that their mothers shopped alone for their clothing. Although the parents had the most to say about whether the teenager would get an article of clothing, the teenagers indicated that they had the most to say about the article that was finally selected.

2. Materials in shoe uppers. A contract has been signed with a private market research firm to study the attitudes and opinions of consumers concerning leather, primarily in shoe uppers. The survey, which will be conducted among approximately 500 men and 500 women in the Philadelphia, Pa. area, will investigate consumers' opinions about the advantages and disadvantages of leather compared to competitive synthetic products being introduced on the market, and their impressions of the desirability of potential improvements in leather for shoes. If necessary, additional interviews will be conducted among users of "Corfam" shoes in an effort to obtain a large enough number for separate analysis. A few questions will also be included on opinions about leather in other clothing items, and natural fibers in shoe uppers. The interviewing on this study is tentatively planned for early 1967.

3. Milk. A study (financed in part by ARS) is underway to evaluate consumer acceptance of powdered dry whole milk, a new product developed by the Dairy Products Laboratory of the Eastern Utilization Research and Development Division, ARS. Over 300 households in the city of Alexandria, Virginia, tried the new product in their homes. Forty-four percent of the respondents felt that the dry whole milk was equal to or better than fresh considering their family's over-all needs and preferences, while 53 percent thought it was not as good. This rating of dry milk does not appear to be related to amount of fresh milk used per week by the family. The disadvantage of the test product which was cited most often concerned the time the milk took to prepare.

A question of special interest is whether or not the problems of foam or residue on the dry milk and difficulties in mixing it were particularly dominant in the thinking of those who gave negative ratings to the milk. Indications are that these reasons do not seem to be given much, if any, heavier weight than all other disadvantages.

These results are selected and preliminary. A final report of the findings of this study will be published in 1967.

4. Pork and beef. A contract has been signed with a private research firm to gather information from a nationwide sample of homemakers on their use of and opinions about meat items, particularly pork and beef. An exploratory study will precede the main survey so that factors pertinent to the main survey will not be overlooked. Questions tentatively will be oriented toward data that underlie the reasons behind increased consumption of beef on one hand and decreasing consumption of pork on the other. The field work on the main survey is scheduled to start early in 1967, and will cover all quarters of that year. The National Live Stock and Meat Board is cooperating with the Department in this study and is providing a portion of the funds for the research.

5. Poultry. A nationwide survey was conducted in the summer of 1964, under contract by a private research firm, to ascertain household consumers' preferences, use patterns, and purchasing practices for broiler-fryers and turkeys. Some of the questions were designed to elicit information for comparison with an earlier (1956) study. The final report on this study has been published. A few highlights from the report (some of which have been discussed in a previous progress report) are outlined below.

The current data show that 97 percent of the interviewed homemakers reported serving broiler-fryers during the year preceding the survey, an increase of 4 percentage points from the earlier study. Frequency of use also increased; almost two-thirds of the users in 1964, compared to half the users in 1956, reported serving broiler-fryers once a week or more often. Price appeared to be the key factor in stimulating more frequent use of broiler-fryers. Increased use of broiler-fryers for weekday meals, winter consumption, and outdoor cooking also seem to account for increased consumption.

Most homemakers reported being able to purchase broiler-fryers in the weight range that suited their family's needs. Purchasers of broiler-fryers were asked to choose characteristics that they felt were most important in selecting these birds. About 7 in 10 chose "one that is well cleaned", "no bruises or discoloration", and "the right size". About 6 in 10 selected "inspected by the government", 5 in 10 choosing "no pinfeathers" and "plumpness".

When asked which of three poultry grade levels--words, letters or numbers--would be the easiest to understand, almost 60 percent selected words, 30 percent chose letters, and only 5 percent felt that numbers would be easiest to understand.

Commercially frozen chicken has not achieved wide acceptance. Only one-third of the women who purchased broiler-fryers in the year preceding the survey reported buying any that were frozen. Major deterrents appeared to be price, availability, and a lack of knowledge as to how long store chicken had been frozen. Home freezing of chicken, however, was popular among homemakers, especially among those with separate freezers.

Homemakers tended to view chicken as a convenient, versatile, economical, and tasty food item. They did not feel that broiler-fryers were particularly suitable for festive occasions, as a meat for sandwiches, or as an item to order when dining out.

The percentage of homemakers who reported serving turkey (76 percent) increased by 11 percentage points since the 1956 study. Most women, however, still served turkey only one to three times a year. Fresh turkeys were preferred over frozen by a three-to-one ratio, while hens were preferred over toms two-to-one.

About two-thirds of all homemakers had bought one or more convenience poultry products during the year preceding the survey. The most popular items with consumers were frozen chicken pies, frozen turkey pies, frozen chicken dinners, and frozen turkey dinners in that order.

6. Noncitrus fruit. A nationwide study of homemakers' use of and opinion about noncitrus fruits, with emphasis on apples, has been completed, and the final report has been sent to the printer. Selected data from this study have been discussed in a previous progress report. A few of the highlights are outlined below.

Nearly every household in the United States had purchased some fresh fruit in the preceding 12 months. A variety of fruits was used in the majority of these homes--better than half of the homemakers indicated that in the past year they had purchased 7 of the 11 fresh fruits covered in the questionnaire.

Homemakers were asked to select from a list of both positive and negative statements those they felt were especially true about six specific fresh fruits--apples, pears, bananas, grapes, peaches, and plums or fresh prunes. While homemakers generally selected the same positive statements for all the fruits, the frequency with which they were mentioned varied according to each fruit's special appeal to the consumer. "Good for health," and "good for snacks or packed lunches," were selected most often for most of the fruits. However, far more associated these statements with apples, for example, (91 and 93 percent), than with plums (66 and 51 percent), and "Can be used in many ways" was also selected by far more homemakers for apples (86 percent) than for plums (20 percent). Negative statements were generally selected less frequently but with proportionately wider variation in frequency. For example, "Messy to eat" was cited by 43 percent of the homemakers for peaches, while only 1 percent mentioned it for apples.

Nearly all homemakers who used fresh apples said they were eaten "out of hand," with better than half also using apples in salads. They were eaten either as daytime or evening snacks in 77 percent of the households; 39 percent of the homemakers reported that apples were carried in a "packed lunch" by family members.

Better than 8 homemakers in 10 said they had used fresh apples for cooking or baking in the preceding year. Apple pies, baked apples, and applesauce were cited most often as uses of apples in cooking or baking. About 6 in 10 of the respondents who reported using fresh apples for cooking or baking said that they used less than half of all the apples they purchased in this manner. The level of apple purchases seemingly was not related to the proportion used for cooking or baking. About 60 percent of both the high and the low purchasers of apples used less than half of the fresh apples they purchased in cooking or baking.

Homemakers who mentioned that they sometimes had difficulty in finding good fresh apples were in the minority (14 percent). About twice as many homemakers (28 percent), however, had been disappointed in apples they had purchased in the past year. They were disappointed mainly with the texture or taste of the apples.

7. Potatoes, rice, and wheat. The fieldwork and coding of data on a nationwide study collecting information from homemakers on their use of and opinions about selected potato, rice, and wheat products have been completed, and preliminary runs of data are currently in process. A final report of the findings of this study will be published during the latter half of 1967.

B. Quality Discrimination

The sensory testing laboratory of the Branch is used to ascertain, under controlled conditions, people's abilities to discriminate among qualities or levels of a quality for food samples, or other sensory or visual stimuli, and the preferences associated with discriminable variables. The products which have been evaluated include new food forms developed in the ARS laboratories or variations of products already available. Studies have been conducted this year on dry whole milk; orange drinks vs. orange juice; dehydrated lemonade, limeade, orange juice and grapefruit juice; three varieties of a new spread-type dairy product; three flavor variations of a new type lo-fat cheese; and dehydrated apple, cherry and grape juices. Some examples of the types of problems investigated are listed below. The results of these studies are not usually published, but are reported by memorandum to the cooperating group requesting the research.

Milk. A series of tests is being conducted to test people's reactions to dry whole milk after varying periods of time in storage at three different temperatures; i.e., 40°, 68°, and 80°, Fahrenheit. This milk is the same product discussed above (1-A-3) which was developed by the Eastern Utilization Research and Development Division, ARS. The most recent test, conducted after the milk had been in storage for 6 months, was to have been the last. However, because the mean preference scores for all three milks remained above the neutral point on the hedonic scale throughout the study, and because additional supplies of the storage milks are on hand, the tests will be continued on a monthly basis for an indefinite period.

Lo-fat cheese. A series of tests was run on three flavor variations of a new lo-fat cheese, developed by the Eastern Utilization Research and Development Division, ARS. The new cheeses had a lower butterfat content (6 percent) and a higher protein content than most cheeses. Tests were conducted to determine differences in preferences among the new cheeses themselves, with no significant differences being found. Two flavor variations of the new cheeses were then tested against a commercially available lo-fat product, which was preferred. Finally, two flavor variations of the new cheeses were tested against a commercially available New York sharp cheddar, and no significant differences among the overall preference scores for these cheeses were found.

Punch drink. Experiments were conducted to determine the relative preference for two commercially available mixed fruit punch drinks as compared with a strawberry-lemon-grapefruit punch drink developed by the Southern Utilization Research and Development Division, ARS. The test product rated significantly above one commercial punch, and favorably, on an overall basis, with the other.

PUBLICATIONS

Consumer Preference

- Anon. 1966. Young People's Use and Appraisal of Natural and Competing Fibers in Wearing Apparel. Marketing Research Report No. 767. (S&R 3-1)
- Clayton, L. Yvonne. 1966. Homemakers' Use of and Opinions About Selected Fruits and Fruit Products. Marketing Research Report No. 765. (S&R 3-6)
- Knott, Edward M. 1966. Homemakers' Opinions and Preferences for Broiler-Fryers and Turkeys. Marketing Research Report No. 760. (S&R 3-8)

AREA NO. 2: IMPROVEMENT OF CROP AND
LIVESTOCK ESTIMATING PROCEDURES

Problem: The Statistical Reporting Service prepares a large number of official estimates for agricultural and related enterprises. These statistics are published in the more than 700 reports issued each year. Due to the large number of estimates made and the limited resources invested for data collection and analyzation, the statistical methods employed by the Service have been those which would produce the most information for the least cost. The principle method of data collection has been the mail questionnaire circulated to a list of voluntary crop reporters who complete and return reports relative to all types of agricultural enterprises and activities. This method of data collection is cheap but returns are both selective and subjective, even though the data reported is in the form of relatives such as condition of crop as a percent of normal, percent change in acres planted, percent of full crop, etc. The persistent bias in the survey data has been removed by charting or projecting these mail survey indications from some base such as five-year census information, or marketing check data. The forecasts and estimates derived from non-probability mailed surveys have been relatively satisfactory over the years. However, in years when changes in inventories, acreages, yields, or prices are unusually large they are not ordinarily fully reflected in the appraisals and reports from selected mail respondents. In situations like this the estimates prepared may lack the required precision when it is needed the most. Since the estimates prepared are translated by users into available supplies of the different commodities, price inequities may occur if the supply is over or under estimated. This can result in serious financial losses for producers and processors of agricultural commodities. This has been particularly true during recent years as farms and processors of farm products have become larger and more specialized.

Modern technology has been responsible for the development of new and improved methods of data collection and estimation. Sample surveys based on probability sampling are more expensive to conduct than the traditional self-selecting mailed survey but they do provide unbiased estimates and their precision can be measured from the sample data itself. The critical need for precision estimates for the agricultural economy makes it imperative that modern statistical theory and methods be developed and incorporated into the collection and analyzation of agricultural statistics. Many new techniques have been developed and introduced into the estimating procedures. However, due to the necessary demand for more and better statistics there is an urgent need for continued research and study to devise more efficient sample survey methods to insure continued improvement in the quantity and quality of SRS statistics.

USDA PROGRAM

The Department of Agriculture conducts a program of applied research designed to strengthen and improve the methodology used in collecting agricultural statistics. The principal disciplines involved are mathematics, statistics and probability but other disciplines relating to a particular subject or field are employed as required. Examples of these subjects are plant physiology, psychology, cartography and photogrammetry. The current program consists of 6.0 professional man-years per year devoted to the study of sampling techniques and survey methods, and 4.0 professional man-years working on methods for forecasting and estimating the yields of important crops. Work under this program is done in Washington, D.C., and in SRS field offices located in the States concerned.

The research objectives in survey methods are associated with the improvement of all aspects of survey design. These include questionnaire design, universe definition, sampling frame construction, sample design and estimators, enumeration techniques, quality checks, editing procedures, methods of processing data and the post-analysis of the survey data and procedures with a view to improvement of sampling and operational designs. In the current program priority is being given to the construction of new area sampling frames for the New England States and Texas, the investigation of sources of lists for farm operators and processors of agricultural products, maintenance and optimum use as sampling frames for probability sampling; and the problem of developing methodology for collecting data by mail and enumeration, in the same sample survey, using lists in conjunction with area frames. A preliminary exploration of the possibility of using aerial photography in estimating acreages of crops and numbers of livestock is being made. In this area, problems requiring study are those of sample design and photo-interpretation as well as the use of this technique to supplement a general-purpose sample survey. Response errors are being studied. Here the objective is to establish communication with the respondent through the medium of a questionnaire which will transmit concepts with a high degree of fidelity and at the same time induce the respondent to reply honestly and fully to questions concerning agricultural activities. An attempt is being made to distinguish between those items for which the respondent has accurate knowledge, those items which he may have once known but no longer recalls accurately, those items which he had never known precisely, and those items for which he is unwilling to divulge information or gives deliberately misleading information. Where applicable, alternative sources of information will be sought and different ways of motivating respondent cooperation will be tested.

Work on objective yields is being continued. This includes the refinement of the forecasting models already in use as well as the development of new forecasting procedures for other important crops. Corn, cotton, wheat, and soybean models are being refined by more detailed analysis of growth patterns and fruit development. The use of ADP for computing parameters based upon larger samples and for broadening the range of plant maturity

recognized by the forecasting models has strengthened early season forecasts of yield. Among the other crops for which objective forecasting procedures are being developed are apples, potatoes, and pasture grasses.

A. Objective Yields

1. Wheat. The 1966 wheat objective yield program was increased to 2,410 samples in 17 States with the addition of 170 winter and 20 spring wheat samples. The sample allocation to States changed slightly from the preceding year based on a compromise between optimum allocation and the necessity to achieve a reasonable standard error for each State.

No weekly development studies for the entire growing season were conducted during 1965 as efforts were directed at analyzing data collected for earlier years. One of the purposes of the weekly development work was to provide information for determining the optimum size and shape of sample plots. Analysis of data collected does not support changing current size and shape of plot from the standpoint of variance only. However, this study is not completed as cost factors have not been completely analyzed.

Analysis of previous data for monthly samples in preparation of forecasting models for the 1966 crop, was done by a comprehensive computer edit and analysis programs. These programs greatly expanded the combinations of variables that could be tested and the different relationships tested for variables used in forecasting the components of yield.

Some work has been completed and study is continuing on the effective use of stratification to increase the precision of early season forecast and preharvest estimates of yield. Irrigated vs. non-irrigated growing areas, environment factors, geographic location, and variety are the stratification criteria under consideration.

Last year studies were undertaken to (1) improve early season counts and measurements for characteristics used in forecasting models for spring wheat, (2) determine the amount of gleanings on the ground prior to harvest and (3) consider the feasibility of counting immature grain by oven drying sample heads prior to threshing.

Plant counts were made in spring wheat fields in North Dakota, Idaho, and Washington on three weekly visits that covered the time period from plant emergence to the time when the stalks reached the flag or early boot stage of maturity. Prior studies indicated that plant count might be a more stable characteristic than stalk count during this part of the growth cycle due to rapid stooling. An analysis of this study indicated that plant counts were not consistently better than stalk count for measuring the number of potential heads to develop.

Preharvest gleanings were made for regular sample units in Montana and South Dakota. Enumerators were instructed to pick up heads, part-heads,

and grain inside the sample unit on the final preharvest visit. The amounts gleaned although small were significant and during 1966 an adjustment was made to account for this difference in determining preharvest net yields.

At present, a ten head subsample from one row outside of one unit of the sample is being used to obtain information to forecast grain weight per head for the sample. The data obtained from this small subsample is highly variable in some instances. Grain count per head is one of the characteristics measured from this subsample. The Oklahoma Regional Laboratory conducted a study on counting grains from immature heads electronically. Heads for the study come from a randomly selected subsample of the regular monthly samples in North Dakota and Washington. All heads from an entire row length outside of one unit were clipped when the maturity stage of a sample was classified as being milk or soft dough. In the laboratory these heads were oven dried prior to threshing. The number of grains that could not be threshed from the heads was significant as compared with the total grain count from heads. Further research to improve counting procedures should be initiated.

During 1966, a plant development study was conducted in two States (Oklahoma and Oregon.) The purpose of this study is to count and measure plant characteristics associated with the development of heads and to collect information relating to the influence of environmental conditions on this factor. Four fields were observed in each State and two samples were located within each field. Weekly visits were made to each field from May 1 until harvest.

2. Soybeans. In 1965, the soybean objective yield study in nine North Central States was conducted in 410 sample fields for the August 1 survey. This number was increased to 840 sample fields for the September 1 survey and to 890 fields for the October 1 and final preharvest surveys. Work was not done in Arkansas and Mississippi on the August 1 survey. Previous studies had established that soybeans in these 2 States generally were too immature at that date for objective counts to be useful in forecasting yields. Studies in these two States were made on 100 samples for the September 1 survey and on a total of 300 samples for the October 1 and final preharvest surveys. Field procedures were unchanged from 1964.

Forecast estimates of the number of pods with beans which would be present at harvest were made for all immature sample for each monthly survey using two different forecasting models. The first model (percent of maximum fruit load) assumes that samples in a particular maturity category are carrying a certain proportion of this maximum fruit load at the time of the survey, and uses this proportion to derive an expected maximum fruit load. This fruit load is adjusted by the fraction of expected pod loss to obtain the predicted number of pods with beans at harvest. The second model (a multiple regression type model) also uses the number of fruit per plant plus additional information such as plan density, nodes per plant, and fruited nodes

and lateral branches per plant for predicting the same component. Both models were tested on the August 1 and September 1 surveys. The regression model was considerably better on the August 1 survey but there was virtually no difference on the September 1 forecasts.

Weekly counts and observations were also made in five additional fields in Arkansas, Missouri, Illinois, and Indiana. These data are being studied to find ways to better define the maturity categories now in use. Also, beans from the weekly samples were analyzed for protein and oil content and for iodine number in the hope that these characteristics could be used in forecasting final bean weight. Results from these tests were not encouraging.

The completion of a general purpose computer analysis program has been made possible both intensive study of the monthly survey data and a more inclusive regression type forecasting model. Additional refinement of the parameters for the regression model will take place as data for additional years is accumulated.

For the 1966 crop season, a total of 900 sample fields will be surveyed monthly in the nine North Central States starting August 1. Observations on a total of 300 fields will also be taken at monthly intervals in Arkansas and Mississippi beginning September 1. Weekly observations will be made in five fields in each of the following States--Maryland, Virginia, North Carolina, South Carolina, Kentucky, Tennessee, and Louisiana. In addition, a total of 350 preharvest samples will be taken in the States of North Carolina, Tennessee, South Carolina, and Louisiana to obtain a final preharvest yield estimate for those States.

3. Irrigated cotton. This study was continued on a scale approaching a fully operational program. The number of sample fields was held at 480 in order to test previous results, and to obtain data for refining forecasting parameters for use in early season forecasting models. Major results of this study are as follows:

- (1) Stratification of California into two separate strata, the Imperial Valley and the San Joaquin Valley area, produced more efficient estimates of yield and reduced total sample size required for a given degree of precision at the State level by about one-third.
- (2) Enough data was obtained to develop reliable models for forecasts in all research States. In addition, all 1964 and 1965 sample data were analyzed more completely using a new ADP program. This analysis developed fruiting characteristics and relationships for new models which appear quite promising.

- (3) Research done in the counting of seed from fully developed large bolls pointed up the possibility of using this seed count to forecast boll weight. Plans for testing this on a small scale during 1966 were made on the basis of research work during 1965.

4. Pasture grasses. Studies aimed at measuring the amount of forage produced and the amount consumed by livestock were conducted under a cooperative agreement with Iowa State University were continued in 1965. Work done in the earlier years had been concerned with determining optimum procedures for estimating growth and intensity. This was done through experimental designs which allowed analysis by cage types (mobile or stationary), plot shapes, time period of observation (one, two, or four weeks), as well as appropriate field techniques and cost structures. The work prior to 1965 was done on University farms and indicated plot variation within pastures and variation among farms were both important sources of variation in seasonal forage production and grazing.

In the summer of 1965, a larger scale study was initiated. This study covered 16 farms in 3 Iowa Crop Reporting Districts. Three plots per farm pasture were randomly located. Each plot consisted of a 3' X 3' cage surrounded by four outside plots. The outside plots were used to determine the amount of grazing and forage available at the start of the study. The caged area determine the production during the time period.

The 1965 study clearly demonstrated the existence of a between farm component of variation in addition to an intra-farm component. It also indicated less variability in grazing estimates than in growth estimates. The 1965 study, as well as earlier, studies, showed that the caged-plot technique using mobile cages provides a feasibly operational method for measuring pasture yields.

5. Apples. Development studies initiated in 1963 were continued in 1965. The purpose of these studies were to develop objective yield forecast procedures based on fruit counts, size measurements, and apple weights from sample trees.

A sample of twenty-five trees from a block of 250 Red York variety apples was selected within a commercial orchard near Front Royal, Virginia. During the first week of July each year, counts were made of apples on one terminal branch of each sample tree. Terminal branches were selected with probabilities proportional to cross-sectional areas of limbs and the counts therefrom expanded by the inverse of the probabilities of selection. Monthly diameter measurements of apples were obtained from sample limbs selected from a subsample of the twenty-five sample trees from July 1 through October 1. Just a few days before harvest, these same apples were given a final diameter measurement and weighed. At harvest time apples for the count limbs were picked, counted, and weighed. During actual farm harvesting operations, the orchard manager had the apples from the sample

trees picked into field crates which were left under the trees for enumerators to weigh. Harvested production figures for the entire Red York block of 250 trees were furnished each season by the orchard manager.

Observations during the three seasons and analysis of the data obtained from the project have resulted in (1) improved counting techniques, (2) better methods of tagging and measuring sample fruit, (3) suggested models for forecasting production in operation surveys, and (4) a promising method of early season projection of size distribution at harvest.

In addition to the above survey results, guidelines have been recommended for future studies in objective yield measurements of tree fruits. Specifically a more intensive approach is needed in which fewer trees would be examined more thoroughly and frequently. This would be necessary in order to better estimate within tree variances of yield and to study the possible use of other parameters. Such an approach should improve the accuracy and efficiency of future tree fruit objective yield projects.

B. Survey Methods:

1. Sampling procedures in Western States. Sample size was increased from 160 to 255 segments in both Oregon and Washington and from 140 to 440 in California for the June 1966 survey. These segments were allocated to strata based on variances from previous surveys. Continuing equalization of segment size in the range stratum has reduced variability and consequently, a large proportion of the additional segments have been placed in the intensively cultivated stratum.

The land use area frame was updated in two areas during the year. In the Snake River Valley in Idaho the intensively cultivated acreage has increased rapidly since the frame was constructed. This expansion occurred largely in the range stratum of the frame reducing the efficiency of the stratification sharply for estimating crop acreages. This increased cultivation also caused enumeration problems in the large range segments. Land which appeared to be intensively cultivated was moved into the existing cultivated stratum. Land with scattered cultivation and land which was being developed were placed in a fringe stratum. This stratum may be combined with the cultivated stratum as further development occurs. Sample sizes were adjusted to reflect the change in land area. In the San Joaquin and Sacramento Valleys of California expanded cultivation into fringes of the range stratum was causing similar problems. This land was moved into the present cultivated stratum and sampled accordingly. In both cases significant gains in the sampling variances were obtained.

2. Aerial photography as a supplementary technique in making crop and livestock estimates. An aerial photo interpretation school was conducted at Berkeley, California in January 1966, and an analysis was made of the livestock test data obtained. In June 1966, a semi-operational aerial photo livestock survey was conducted over a 3,800 square mile area in the upper Sacramento Valley of California.

The purpose of the aerial photo interpretation school was to provide, under controlled conditions, a test of differences between photo interpreters in accuracy of identifying livestock species and actual ground enumeration of animals and time required to interpret various kinds of photos. These factors were observed under varying conditions of (1) type of photography, (2) photographic scale, (3) color of background, (4) type of land use, (5) type of livestock, and (6) animal density. For accuracy of identification, (1) color stereo was better than color non-stereo, (2) color stereo was better, but not significantly better, than panchromatic stereo, and (3) differences in ability to interpret exists between interpreters but narrows with training. For enumeration of animals, (1) there is a tendency to overcount using stereograms, but this tendency can be avoided using proper techniques, (2) there is a tendency to undercount using non-stereo, (3) sheep are less likely to be undercounted than cattle, and (4) differences exist between photo interpreters in the ability to enumerate accurately. For time to interpret photos, (1) stereo takes longer than non-stereo, (2) slowness in interpretation is associated with lower accuracy of identification. In neither accuracy of identification, or enumeration, nor time to interpret, were there any significant differences between (1) types of photography (color or black and white), (2) color of background, or (3) scales tested.

The aerial photo livestock survey was conducted using panchromatic film at scales of 1/8000 and 1/6100. Eight flight strips were systematically selected out of a total of 45 with probabilities proportional to lengths, since all strips were three miles wide. Within each sample, four random coordinates were selected, and sample segments constructed around each point. The segments constructed were ground enumerated usually on the same day of the aerial photo for the strip was made. Ground photography was taken at the time of overhead flights to provide checks on interpretation. In addition, a separate low altitude supplement survey was made in which cattle concentrations were purposefully selected and photographed. The low altitude supplement was used only in a few locations to test the feasibility of using such a technique as the main concentration of effort in future surveys. An analysis of results of the livestock survey will be made during the 1966-67 year. Results of this analysis is expected to help determine the future course of research on this project.

3. Sampling procedures in the Eastern States. The construction of a new area sampling frame for the six New England States was completed early in 1966 in sufficient time to be used in the June Enumerative Survey. In these six States, the entire land area was classified according to its current use. The primary land use strata were (1) intensively farmed land; (2) extensively farmed land; (3) marginally farmed land; (4) land used primarily for urban, business or industry purposes; and (5) non-agricultural land (land documented to have no or at most minute agricultural activities).

The new frame plus information obtained from adjoining States with similar land use strata definitions was used as the basis for allocating sampling units for the June 1966 Enumerative Survey in these six States. Results from the June 1966 Survey in the States concerned showed substantial gains in sampling efficiency as the relative variation of estimates for numbers of farms and major livestock and crop items was reduced.

Prior studies on information obtained from the pilot 1964 June Survey in New York, Pennsylvania, and Florida showed a need for some additional controls on size and numbers of farms per sampling unit in the extensively farmed land stratum would improve the over-all efficiency of the frame. These controls were used in drawing the June Survey segments for the seven States which became operational in 1965 as well as the 1966 segments in the New England States. Additional study of 1965 data in New York and Pennsylvania indicates that tighter controls of size, numbers of farms, as well as numbers of tracts (interviews) are desirable. This control would involve the assignment of sampling units to blocks of land within strata by letting area, expected numbers of farms, and expected numbers of tracts act as variables. Further investigation in this area is contemplated.

4. Response and other non-sampling errors. A follow-up study was initiated after the 1965 June Enumerative Survey in an effort to explore and determine causes of significant differences in livestock inventory estimates from the open and closed enumerations. For sampling purposes livestock for the closed segment technique are associated with the segments if they are within the segment at the time of enumeration. For the open segment technique livestock are associated with the segment for an entire farm only if the farm operator resides in the sample segment. These estimates have the same expected value, but significant differences have persisted in the estimates from the enumerative surveys. Livestock estimates from the closed segments generally have been 10 to 15 percent higher than those from the open, but sampling errors from the closed segments have been smaller.

The operators of selected tracts in Missouri, Arkansas, and Kentucky were re-interviewed about a week to ten days after the regular June Survey, this time the entire farm (open segment) data were collected for each parcel of land making up the farm and these pooled to a farm total rather than collecting totals for the farm as a whole. A parcel was defined as "land not bounded by other land in the farm, under one tenure arrangement, and not divided by the segment boundary."

Since the interview followed the June Survey by approximately one week, an additional section was added to the questionnaire for information on sales, purchases, births, deaths, etc., and movement between parcels since the original interview for the June Survey.

The data for each tract were adjusted for sales, births, purchases, and movement since the June Survey in an effort to establish the exact situation which existed at the time of the first interview. This made the livestock numbers comparable with those from the original June enumeration.

The subsampled data were expanded and compared with similar data collected from the corresponding closed segment tracts of the regular June Survey. Differences between the two surveys for identical tracts were examined to determine reasons for the differences between the estimates from the different kinds of sampling units.

From these comparisons, the following was apparent: (1) For closed segments the adjustments from the re-enumeration, while tending to be upward, were quite small. (2) The open segment adjustments were much larger and, for most items, resulted totals comparable to estimates from the closed segment.

Since most differences between the closed segment estimates were found to be non-significant when comparing the two follow-up surveys techniques, the differences observed between the closed and open segment data for the 1965 June Enumerative Survey can be explained by examining the nature of the differences between the open segment estimates for both surveys. The reasons for the differences between the June and follow-up data were tabulated for the five livestock inventory items.

The "reasons for differences" fall largely in the following categories: (1) different respondent, (2) additional operators, (3) livestock data estimated or missed for segments, (4) non-owned livestock omitted, (5) refusals, (6) change in location, and (7) omitted livestock outside the segment which should have been included in the open segment data.

The important points demonstrated with regard to open segment enumeration of cattle are summarized as follows: (1) Of the 27 percent more cattle reported during the re-enumeration survey than the June Survey, nearly 80 percent were located outside the segment boundaries, and of these, 65 percent were on land rented by the operator. (2) Generally as the distance of the parcels increase from the farm headquarters, a higher percent of cattle were omitted; and (3) Of the total cattle reported outside the segment boundaries during the re-enumeration survey, about 40 percent were not reported during the June Survey.

The purpose of this study was to isolate and evaluate the causes of large response differences between the closed and open segment estimates for certain livestock characteristics in the June Enumerative Survey, and to determine the more nearly correct level. The study showed clearly that the levels of closed segment estimates (particularly for cattle) are about right, and that the estimates from the open segment were consistently low. This conclusion is substantiated by the t-tests and the levels of the ratio

estimates, and is reinforced by the fact that most of the estimates from the June Survey for the closed segment estimates and from the re-enumeration for both the closed and the open segment estimates are within one sampling error of each other. However, the study did show that accurate livestock responses can be obtained from farm operators for the entire farm when collected by parcels and then summed to a farm total.

*Initiated during reporting year
**Discontinued

LINE PROJECT CHECK LIST -- Reporting Year July 1, 1965 to June 30, 1966

Work & Line Project Number	Work and Line Project Titles	Work Locations During Past Year	Line Proj. Summary of Progress	Incl. in Area & Sub-heading
S&R 4	Improvement of Crop and Livestock Estimating Methods.			
S&R 4-1 (Rev.)	Studies on the relationship of individual cuttings of hay to the total hay production and techniques for building lists of farm operators for probability surveys.	Ames, Iowa	Yes	2-A-4
S&R 4-3	Development of improved sample procedures for crop and livestock estimates in Western States.	Wash., D.C. & State offices in: Calif., Idaho, Oregon, & Wash.	Yes	2-B-1
S&R 4-5 (Rev.)	Development of improved forecasts and estimates of wheat yields.	Wash., D.C. & State offices in: Texas, Okla., Ill., Ind., Kans: Mich., Mo., Neb.: Ohio, Colo., Mont., Idaho Wash., Oreg., S. Dak., N.Dak., & Minn.	Yes	2-A-1
S&R 4-6	Development of improved forecasts and estimates of soybean yields.	Wash., D.C. & State offices in: Ind., Iowa, Kans: Mich., Minn., Miss., Mo., Neb.: & Ohio	Yes	2-A-2
S&R 4-8	Improvement of yield forecasts on sour cherries and apples through objective fruit counts and measurements.	Wash., D.C. & State offices in: Mich., & Va.	Yes	2-A-5
S&R 4-9	Development of improved forecasts for the yield of irrigated cotton.	Wash., D.C. & State offices in: Ariz., Calif., & N. Mex.	Yes	2-A-3
S&R 4-10	Probability mailing list from screened segments.	Wash., D.C.	No	
S&R 4-12	The study of lists of farm operators as sampling frames for collecting agricultural statistics.	Washington, D.C.	No	
S&R 4-13	Study of response and other non-sampling errors.	Wash., D.C. & State offices in: Ark., Ky., & Mo.	Yes	2-B-4
S&R 4-14	Study of aerial photography as a supplementary survey technique in making crop and livestock estimates.	Wash., D.C. & State office in: Calif.	Yes	2-B-2
S&R 4-15	Development of improved sample survey procedures for crop and livestock estimates.	Wash., D.C. & State offices in: New England, Texas & Okla.	Yes	2-B-3

